Rashba spin-orbit interaction at the magnetic metal surfaces

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In this talk I will present our results on angle-resolved photoemission investigations of rare-earth metal surface states using Gd, Tb and their surface monoxides as examples. The experimental results reveal that the surface state energy dispersion depends on the relative orientation of the electrons propagation direction and the magnetization direction of the sample. While for the pure metal surfaces only the majority state of the exchange split surface states is occupied, both minority and majority states appear below the Fermi level upon oxygen adsorption. Angle-resolved photoemission experiments directly demonstrate that the observed effect is caused by spin-orbit interaction.

A comparison of the experimental dispersion of Gd(0001) and O/Gd(0001) surface states with first-principles DFT calculations including spin-orbit interaction gives evidence that this behavior is a direct manifestation of the Rashba effect, a relativistic effect which is well known in the field of semiconductor heterostructures. I will address the differences between nonmagnetic and magnetic surfaces and discuss why this effect is observable at some surfaces but negligible for others. I will demonstrate that it can be manipulated, for example, by oxygen adsorption, which leads to a strong modification of the near-surface electronic structure and to an increased spin-orbit interaction. Finally, I will illustrate how the Rashba effect can be utilized as an instrument to investigate 2-dimentional electron spin structures.